F I N A L R E P O R T

ENERGY SAVINGS OPPORTUNITY SURVEY
ENERGY ENGINEERING ANALYSIS PROGRAM

F O R T J A C K S O N
S O U T H C A R O L I N A

EXECUTIVE SUMMARY

Administered by
Savannah District, Corps of Engineers
Contract No. DACA21-85-C-0614

19971023 132

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FINAL REPORT

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ENERGY ENGINEERING ANALYSIS PROGRAM

F O R T J A C K S O N

EXECUTIVE SUMMARY

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Savannah District Corps of Engineers
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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

I. INTRODUCTION

This is the pre-final submittal of an Energy Savings Opportunity Survey (ESOS) performed at Fort Jackson, S.C. This report presents potential energy conservation projects for this Installation. These projects, consisting of Energy Conservation Opportunities (ECOs), are summarized in Tables 1 and 2. The projects were developed based on project packaging instructions from the Installation and on follow-up phone calls with Directorate of Engineering and Housing (DEH). The ECOs have been extended to include buildings similar to those surveyed by the architect/engineer. Similarity was based on instructions from the Installation and on follow-up phone calls with DEH.

Table 3 lists the buildings surveyed. 55 buildings were surveyed totaling approximately 1.5 million square feet. Of these, 32 were examples of Family Housing and 23 were examples of non-housing buildings. Over one hundred ECOs were considered at Fort Jackson. Of these 34 were applicable in non-housing and 8 in Family Housing.

ECOs were selected for consideration from a number of sources: Annexes A and B of the Scope of Work (SOW), the Army Facility Energy Plan appendix, and Heery's own resources, including the ECOs studied at other Installations. All applicable ECOs were evaluated and found either feasible (savings to investment ratio greater than or equal to one) or infeasible. Tables 4 and 5 list the applicable ECOs along with savings to investment ratio (SIR), project packaged, and other pertinent data.

The method of analysis employed for heating and cooling ECOs is a multiple measure approach using a modified bin method as outlined in the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Fundamentals. ECO savings not based upon heating or cooling loads use standard ASHRAE or Institute of Electrical and Electronic Engineers (IEEE) formulas. Electronic spreadsheets employing the aforementioned energy analysis methodologies were used by Heery to perform the energy calculations, and produce the Life Cycle Cost Analysis (LCCA) sheets.

All energy savings are first calculated at the building boundary. For those buildings receiving chilled water or high temperature hot water or other energy from a central energy plant, the computed energy savings are then converted to plant energy savings by the use of conversion factors that reflect distribution losses and energy conversion inefficiencies.

TABLE 1

SUMMARY OF ENERGY CONSERVATION PROJECTS (Non-Housing)
FORT JACKSON, SOUTH CAROLINA

Proj No.	Funding Program	Project Title	ECO No(s).	Energy Savings MBTU/Yr.	First Yr. Dollar Savings $/Yr.	Total Investment Cost $	Simple Payback Period Yrs.	SIR
1	QRIP	Improvements to Motors and Controls	10,13,22,24	18,457	$102,575	$91,464	0.89	13.67
2	PECIP	Improvements to Lighting, Motors, and Hot Water Controls	14,15,18,20 23,29,31	13,229	$217,485	$664,105	3.05	3.69
		Summary		31,686	$320,060	$755,569	2.36	4.90

TABLE 2

SUMMARY OF FAMILY HOUSING PROJECTS
FORT JACKSON, SOUTH CAROLINA

Proj No.	Funding Program	Project Title	ECO No(s).	Energy Savings MBTU/Yr.	First Yr. Dollar Savings $/Yr.	Total Investment Cost $	Simple Payback Period Yrs.	SIR
3	PECIP	Low Flow Showerheads and Faucet Aerators	FH-1	35,514	$269,282	$523,748	1.94	9.55
4	PECIP	Improvements to Lighting and Hot Water Systems	FH-2,FH-6	93,760	$1,132,540	$3,387,162	2.99	4.92
		Summary		129,274	$1,401,822	$3,910,910	2.79	5.54

TABLE 3

SURVEYED BUILDINGS LIST
FORT JACKSON, SOUTH CAROLINA

Building Number	Building Usage	Building Area Square Feet
1892	Barracks	58,446
1895	Reception Station	138,139
2009	Gym	20,076
2119	Administration/Classroom	67,134
2179	Administration/Classroom	48,331
2200	Supply/Administration	12,140
2205	Barracks	41,496
2300	Classroom	67,661
2310	Administration	6,150
2335	Chapel	8,480
2340	Adminstration	9,853
2435	MEPS	43,809
2464	Barracks	22,266
2785	BOQ	83,045
3319	Theater	16,992
3392	Rec Center	28,132
3606	Family Housing	2,563
3612	Family Housing	2,435
3704	Family Housing	2,033
3721	Family Housing	1,637
3737	Family Housing	1,695
3773	Family Housing	1,176
3803	Family Housing	1,795
3809	Family Housing	1,161
4200	Supply/Administration	12,140
4310	Adminstration	6,150
4392	Theater	9,705
4400	Post Office	8,792
4420	Bn Barracks	329,165
5482	Bn Barracks	329,165

TABLE 3

SURVEYED BUILDINGS LIST
FORT JACKSON, SOUTH CAROLINA

Building Number	Building Usage	Building Area Square Feet
5717	Family Housing	1,552
5725	Family Housing	1,411
5727	Family Housing	1,372
5730	Family Housing	1,392
5731	Family Housing	2,600
5780	Family Housing	1,125
5789	Family Housing	1,333
5802	Family Housing	1,392
5803	Family Housing	1,042
5804	Family Housing	1,628
5845	Family Housing	1,361
5892	Family Housing	1,568
6704	Family Housing	1,454
6712	Family Housing	1,430
6825	Family Housing	1,158
6831	Family Housing	964
6833	Family Housing	1,158
6935	Family Housing	964
7030	Family Housing	1,158
7040	Family Housing	1,457
7041	Family Housing	1,071
7043	Family Housing	2,836
7044	Family Housing	1,600
7050	Family Housing	1,636
9810	Reserve Center	37,876

Total Square Footage	1,454,300

II. RESULTS

A. Non-Housing

Of the 34 ECOs found to be applicable in non-housing, 27 had SIRs greater than or equal to one and 23 had paybacks less than ten years. The 11 ECOs selected by the base were packaged into 2 Projects. Figure 1 on page 7 illustrates the SIRs for all 34 ECOs and is ranked by ECO number. Table 4 provides ECO names and numbers, SIRs, and other important data.

Figure 1 shows that SIRs range from over 20 to less than one. The top five ECOs have SIRs above 10. These ECOs are mostly straight forward and low-tech, which means easy implementation.

Figure 2 is similar to 1 but shows "first year dollar savings" for each ECO. This figure shows that the most dollar savings don't always come from the ECOs with the highest SIRs. Figures 3 and 4 illustrate SIRs and dollar savings by Project.

TABLE 4

SUMMARY OF NON-HOUSING ECOs
FORT JACKSON, SOUTH CAROLINA

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr.	First Yr. Dollar Savings $/Yr.	Total Cost $	PB Period Yrs.	SIR
1	Ceiling/Attic Insulation	--	313	2,445	16,911	6.9	2.34
2	Solar Film	--	351	1,867	19,812	10.6	1.03
3	Weatherstrip/Caulk Doors &/or Windows	--	265	1,344	16,374	12.2	1.70
4	Decentralize DHW System	--	34,503	125,412	983,981	7.8	1.22
5	New DHW Units	--	-3	226	3,996	N/A	0.28
6	New Lower Ceiling	--	154	753	35,163	N/A	0.46
7	Pipe Insulation	--	303	1,483	2,299	1.6	13.27
8	Insulation on DHW Unit	--	4	27	782	N/A	0.23
9	Steam Trap Replacement	--	16,056	78,352	17,110	0.2	21.94
10	Outside Temp. Control of Space Heating	1	16,587	88,530	64,106	0.7	17.60
11	Thermostatic Control Valve	--	161	784	14,571	N/A	0.75
12	More Efficient Boiler	--	722	3,928	33,116	8.4	2.53
13	Two Speed Motors	1	781	5,951	15,012	2.5	3.82
14	High Efficiency Motors	2	809	12,210	52,734	4.3	2.28
15	High Torque Drive Belts	2	428	8,204	35,243	4.3	2.08
16	Lamp Retrofit - Incandescent to Fluorescent	--	1,515	37,198	56,150	1.5	7.63
17	Wall Insulation	--	467	2,330	27,401	11.8	1.72
18	Lamp Retrofit - Incandescent to HID	2	660	11,913	26,199	2.2	5.22
19	Fixture Retrofit-Incandescent to HID	--	50	894	7,413	8.3	1.38
20	Fixture Retrofit - Incandescent to Fluorescent	2	1,776	45,084	139,150	3.1	3.73
21	More Efficient Street Lighting	--	121	921	29,362	N/A	0.35
22	Occupancy Sensors	--	998	7,600	11,436	1.5	5.02
23	Daylighting Controls	2	251	4,821	10,486	2.2	3.17
24	Hot Water Reset	1	91	497	910	1.8	7.64
25	Deciduous Shade Trees	--	193	964	15,895	16.5	1.33
26	Time Control of HVAC	--	6,431	35,431	22,086	0.6	20.05
27	Window Back Panel	--	2,673	13,979	100,426	7.2	2.83
28	Storm Window Retrofit	--	45	226	5,789	N/A	0.54
29	4 Lamp Fixture - Install Reflector and Delamp	2	7,416	125,606	379,654	3.0	3.79
30	Airside Drybulb Economizer Cycle	--	1,582	7,908	36,186	4.6	2.98
31	Time Control of DHW	2	1,889	9,647	20,638	2.1	6.31
32	Removable Valve Insulation	--	141	686	3,418	5.0	4.13
33	Electric Spark Pilot Retrofit	--	4	20	383	N/A	0.49
34	Dock Curtains	--	3,641	17,990	15,633	0.9	3.28

Figure 1

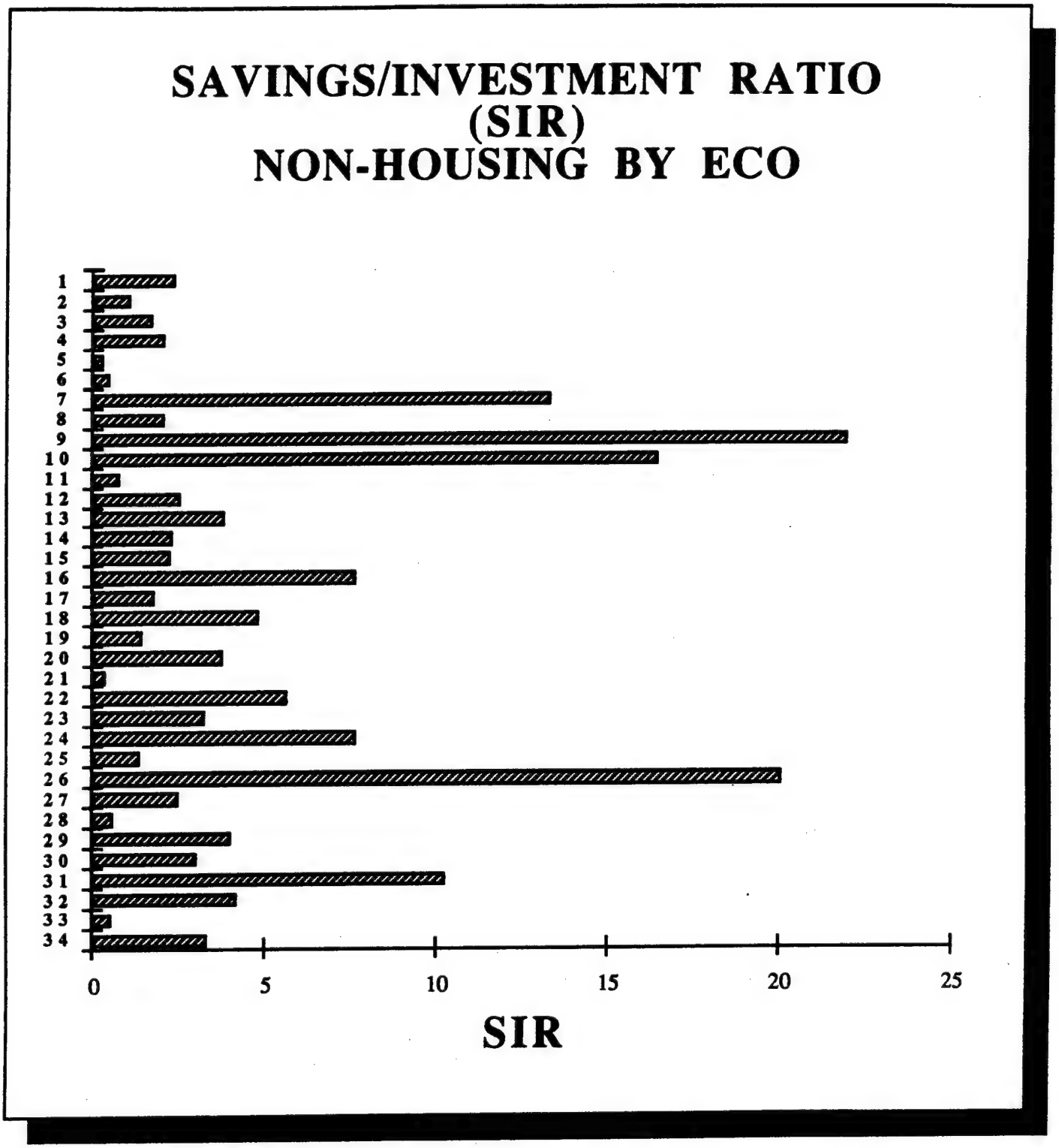

SAVINGS/INVESTMENT RATIO
(SIR)
NON-HOUSING BY ECO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
0
5
10
15
20
25
SIR

Figure 2

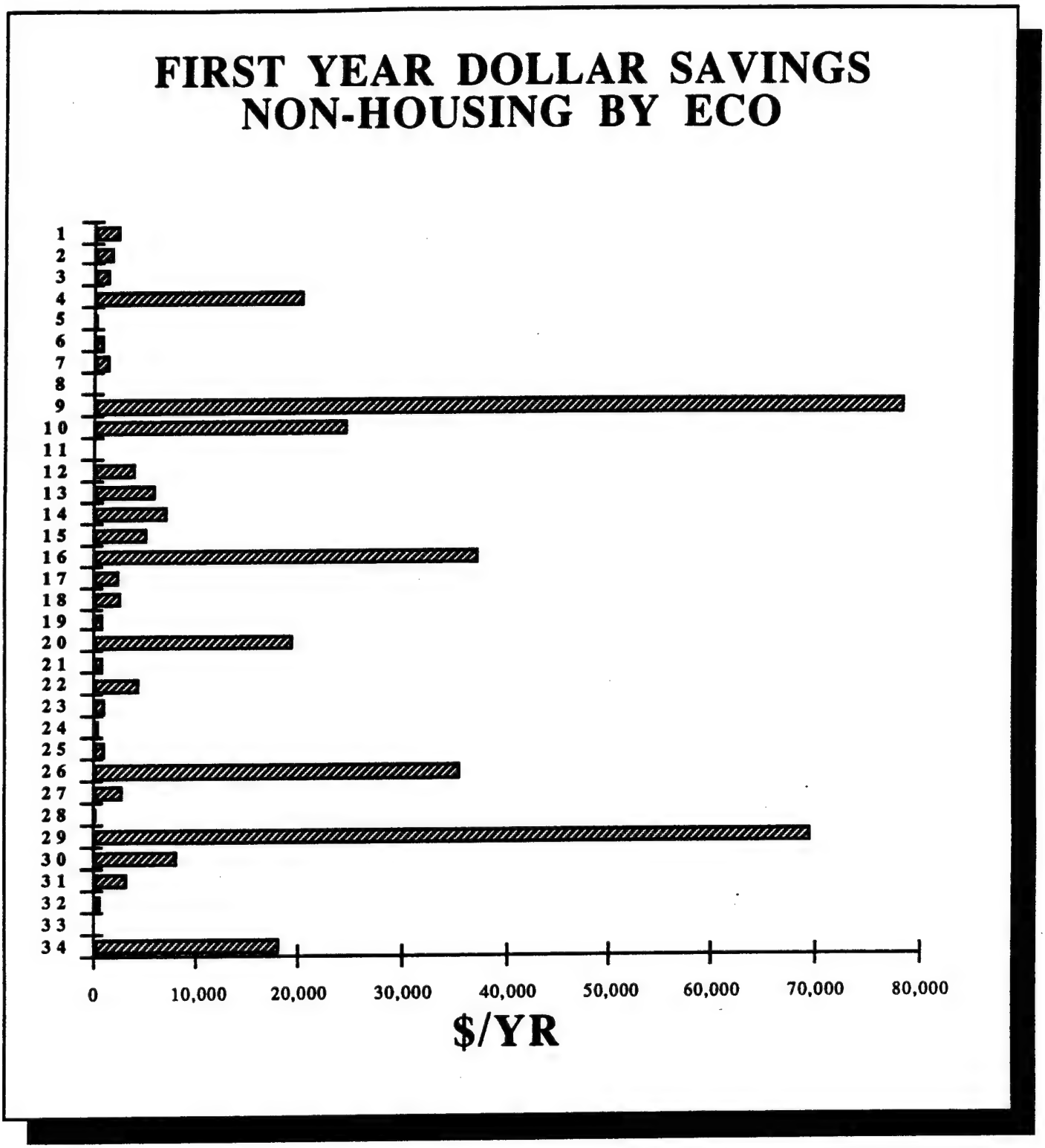

FIRST YEAR DOLLAR SAVINGS
NON-HOUSING BY ECO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
$/YR

Figure 3

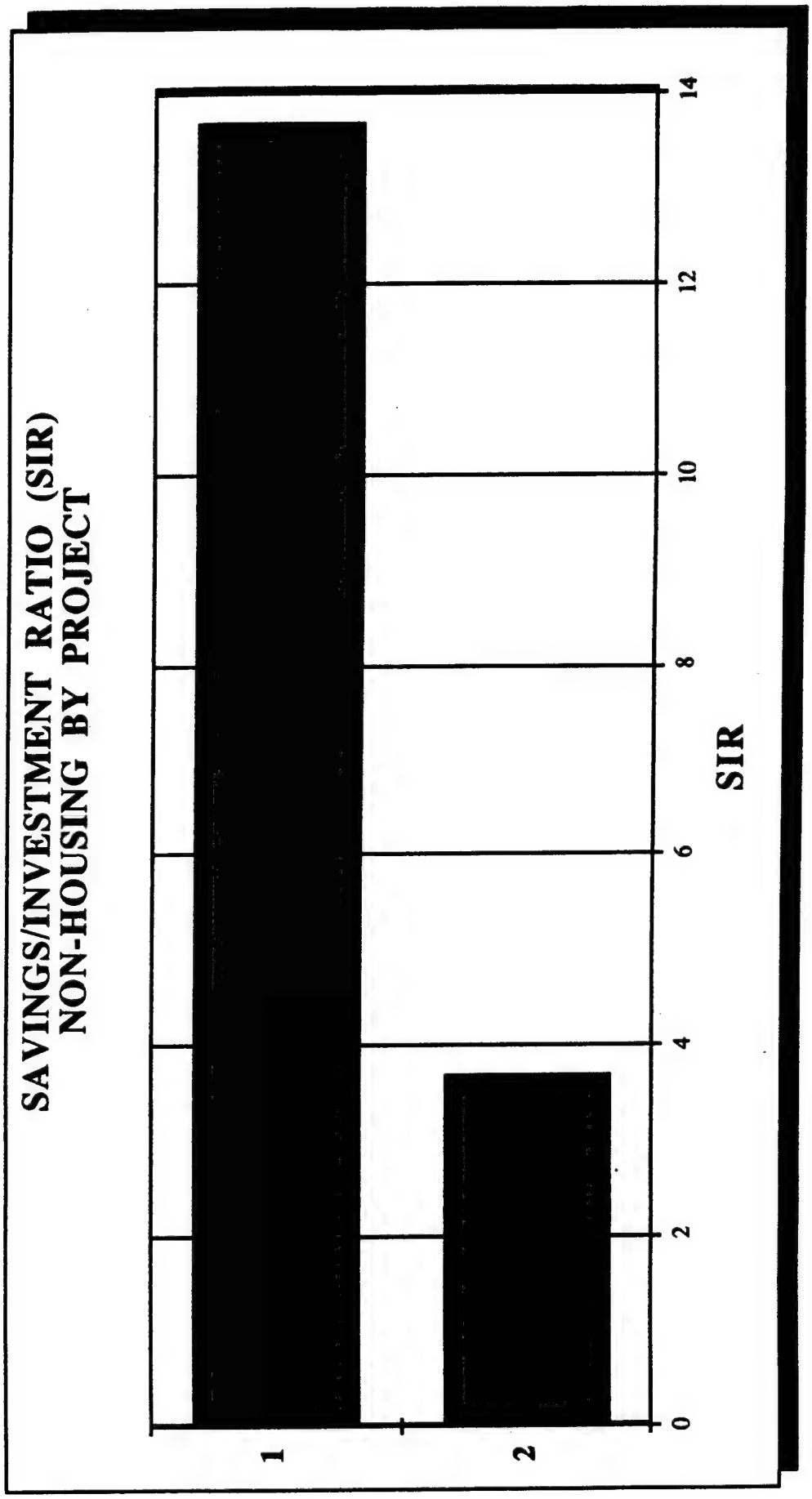
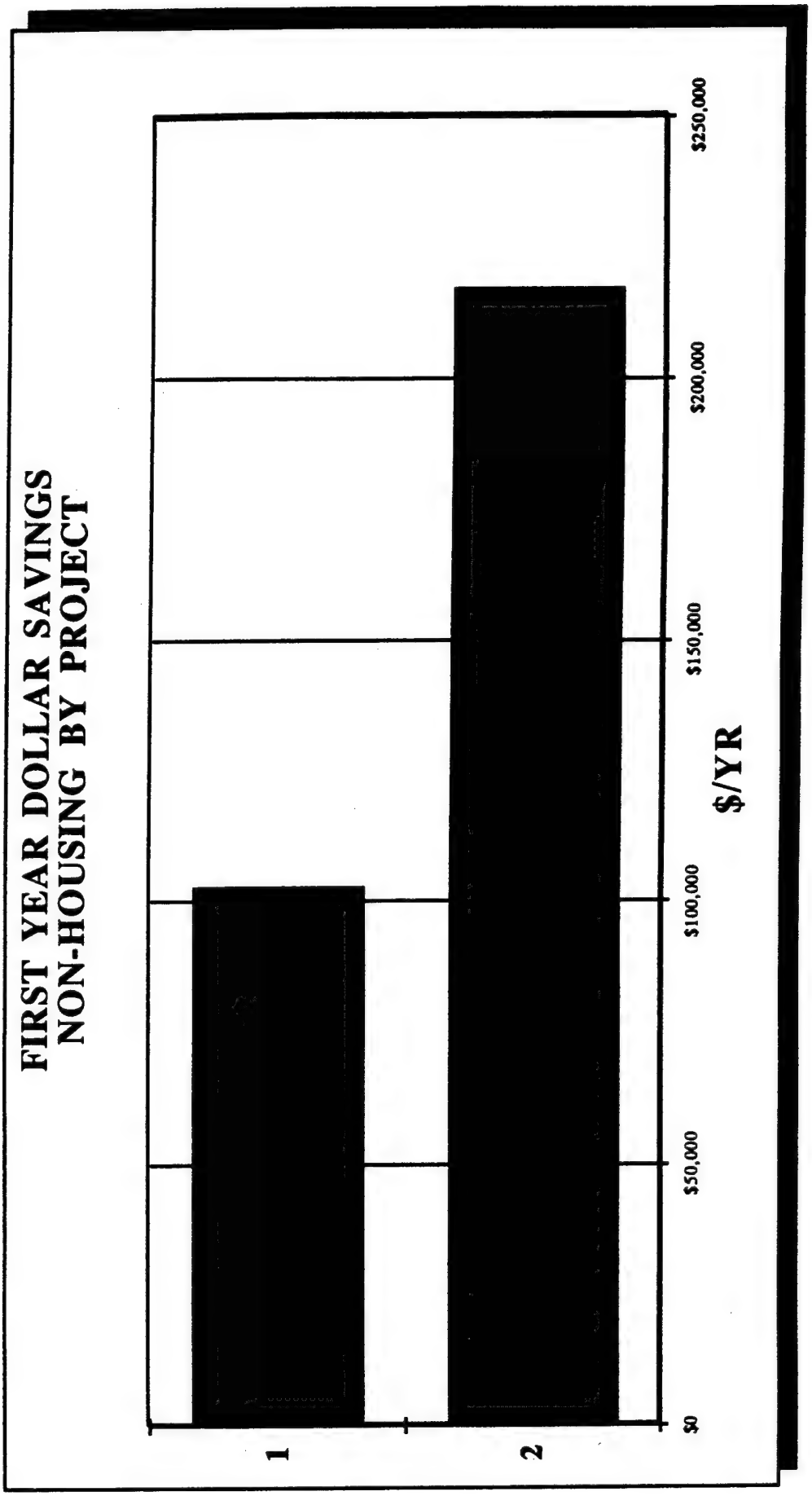

SAVINGS/INVESTMENT RATIO (SIR)
NON-HOUSING BY PROJECT
SIR
0
2
4
6
8
10
12
14
1
2

Figure 4


FIRST YEAR DOLLAR SAVINGS
NON-HOUSING BY PROJECT
$250,000
$200,000
$150,000
$100,000
$50,000
$0
$/YR
1
2

B. Family Housing

Of the 8 ECOs found to be applicable in family housing, 6 had SIRs greater than or equal to one and paybacks of less than ten years. Three have been programmed into projects. Figure 5 on page 13 illustrates the SIRs for all 8 ECOs and is ranked by ECO number. Table 5 provides ECO names and numbers, and other important data.

The SIRs range from nearly 10 to less than one. The top two ECOs have paybacks less than three years. These ECOs are fairly simple, straight forward and low-tech.

Figure 6 is similar to 5 but shows "first year dollar savings" for each ECO. This figure shows that the most dollar savings don't always come from the ECOs with the highest SIRs. Figures 7 and 8 illustrate SIRs and dollar savings by Project.

TABLE 5

SUMMARY OF FAMILY-HOUSING ECOs
FORT JACKSON, SOUTH CAROLINA

ECO No.	ECO Title	Proj. No.	Energy Savings MBTU/Yr.	First Yr. Dollar Savings $/Yr.	Total Cost $	PB Period Yrs.	SIR
FH-1	Low Flow Showerheads & Faucet Aerators	3	35,514	269,280	523,748	1.9	9.55
FH-2	Pipe Insulation & Heat Traps	4	67,781	368,731	1,013,769	2.7	7.75
FH-3	Furnace Retrofit	--	4,097	22,288	75,573	3.4	4.12
FH-4	Insulation on DHW Unit	--	4	21	155	7.5	1.28
FH-5	Electric Spark Pilot Retrofit	--	4	20	383	N/A	0.49
FH-6	Fixture Retrofit - Incand. to Fluor.	4	25,979	763,809	2,373,392	3.1	3.71
FH-7	Solar film	--	3	48	635	N/A	0.59
FH-8	Weatherstrip/Caulk Windows/Doors	--	29	186	3,000	16.1	1.19

Figure 5

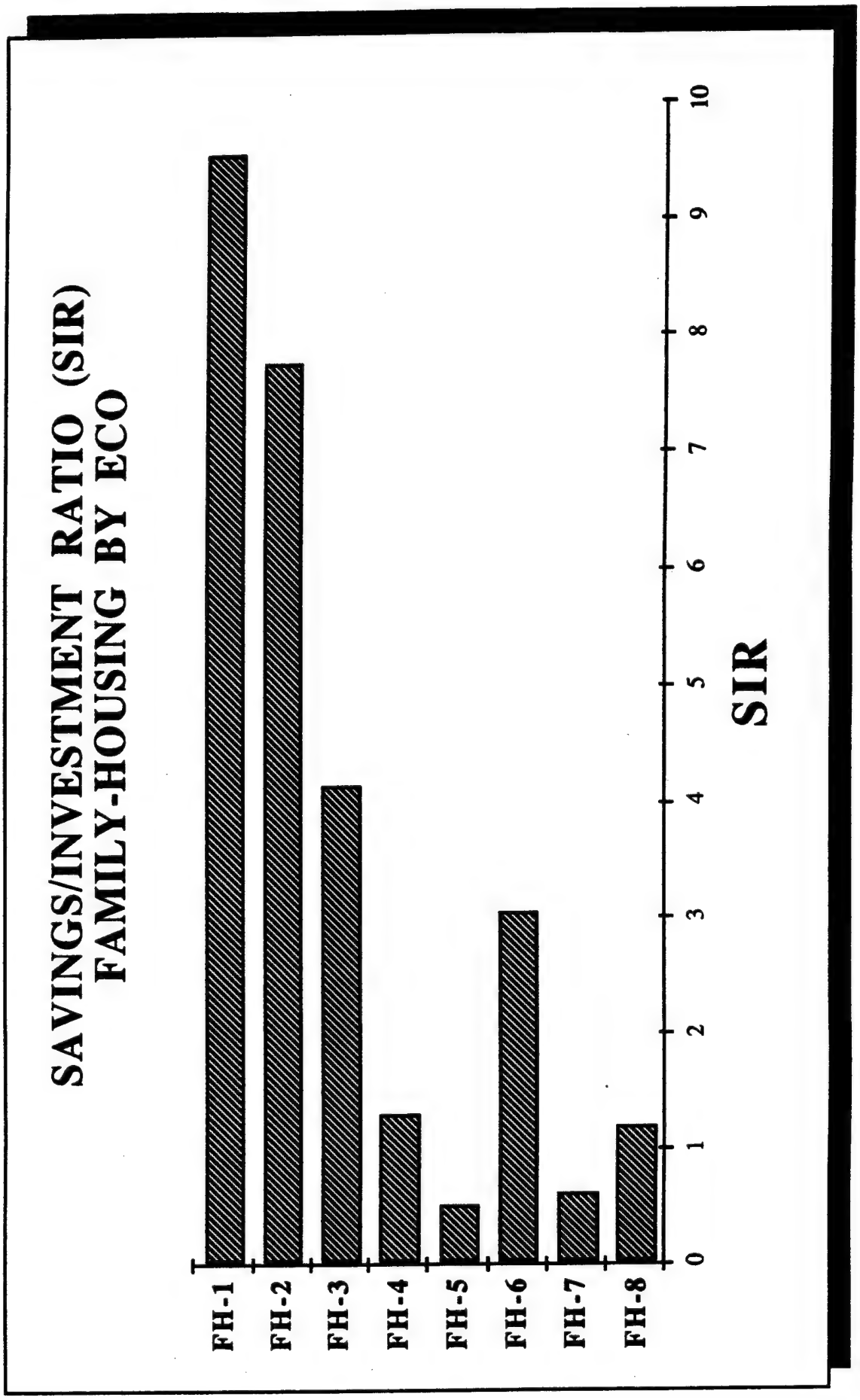

SAVINGS/INVESTMENT RATIO (SIR)
FAMILY-HOUSING BY ECO
FH-1
FH-2
FH-3
FH-4
FH-5
FH-6
FH-7
FH-8
0
1
2
3
4
5
6
7
8
9
10
SIR

Figure 6

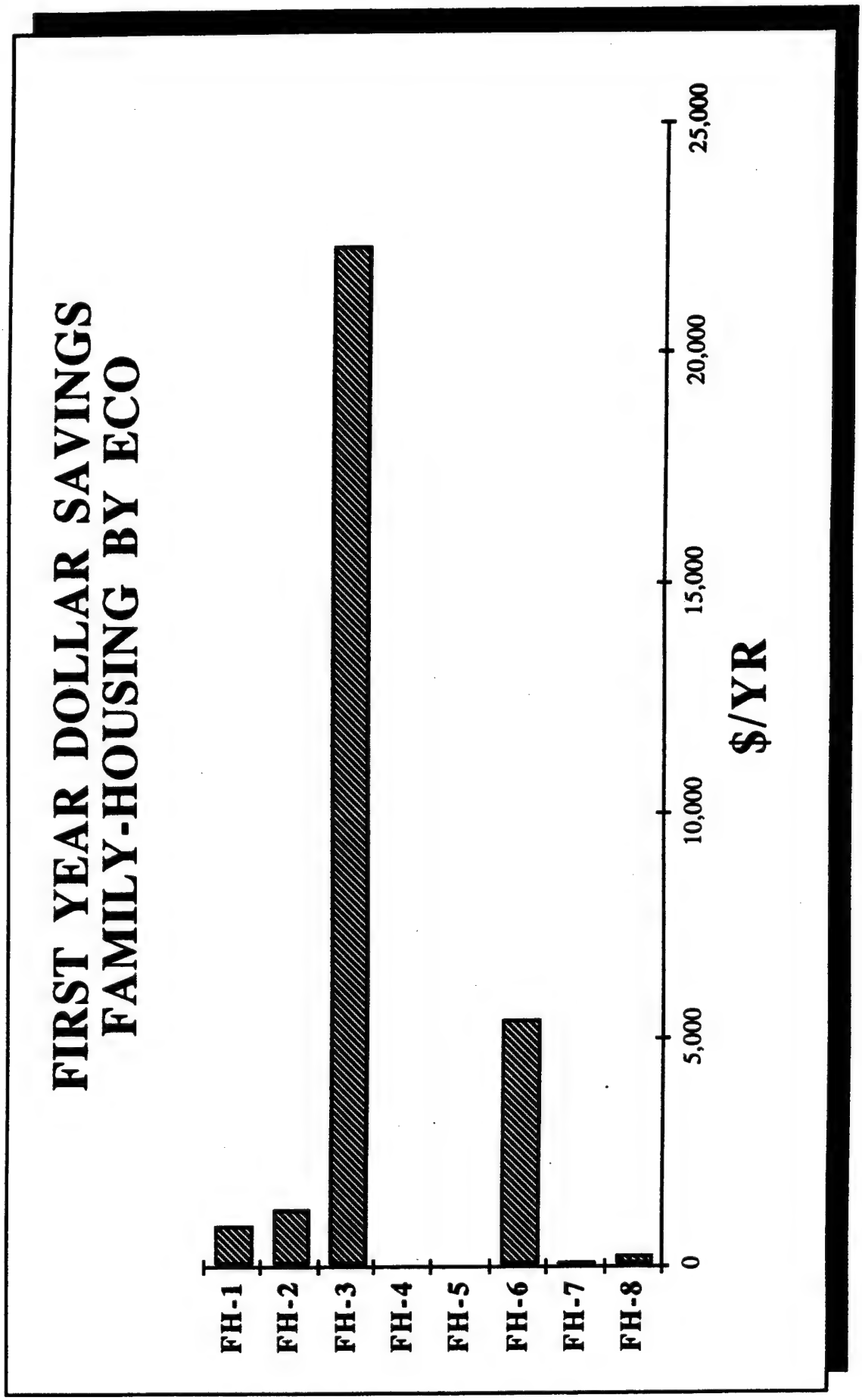

FIRST YEAR DOLLAR SAVINGS
FAMILY-HOUSING BY ECO
FH-1
FH-2
FH-3
FH-4
FH-5
FH-6
FH-7
FH-8
0
5,000
10,000
15,000
20,000
25,000
$/YR

Figure 7

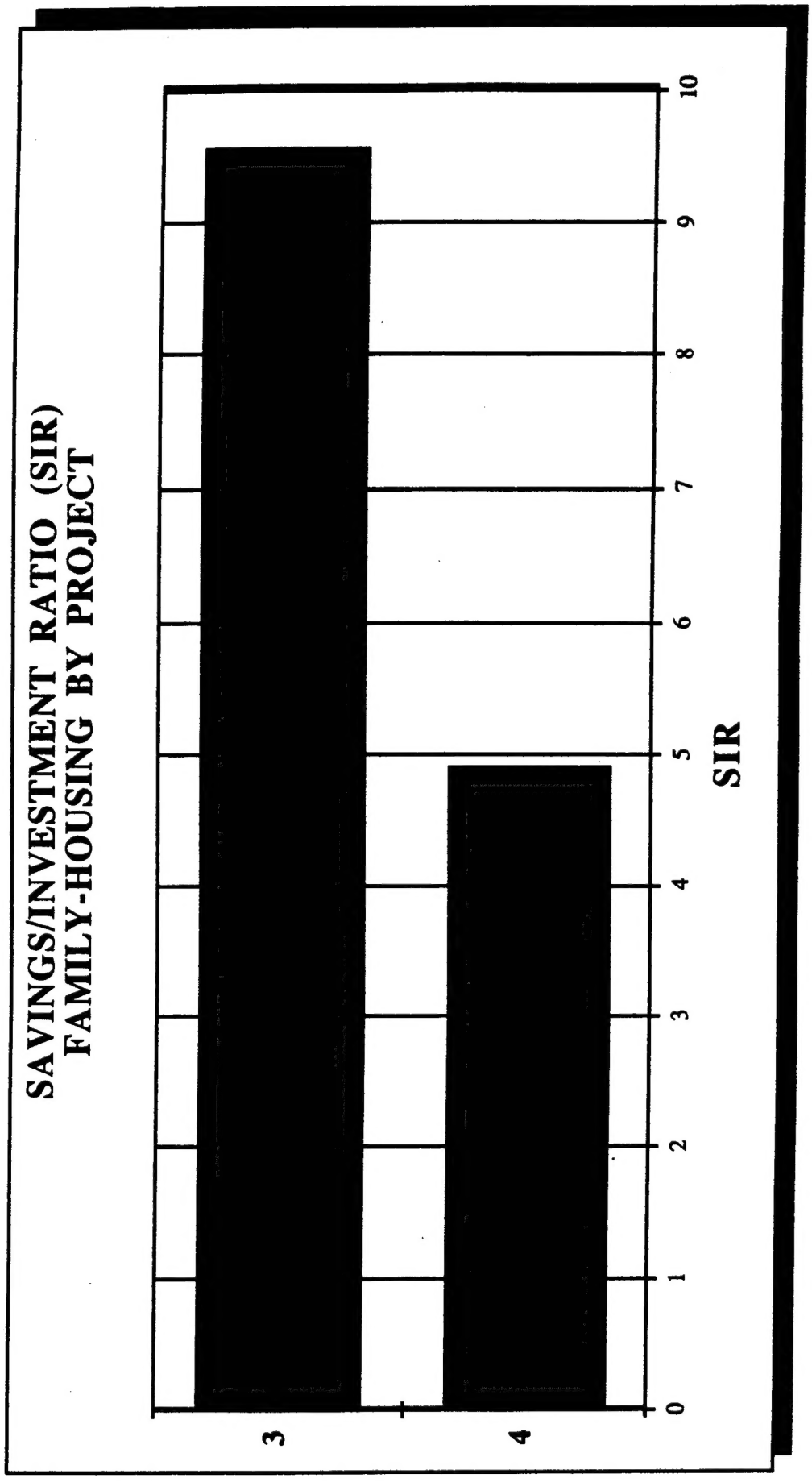
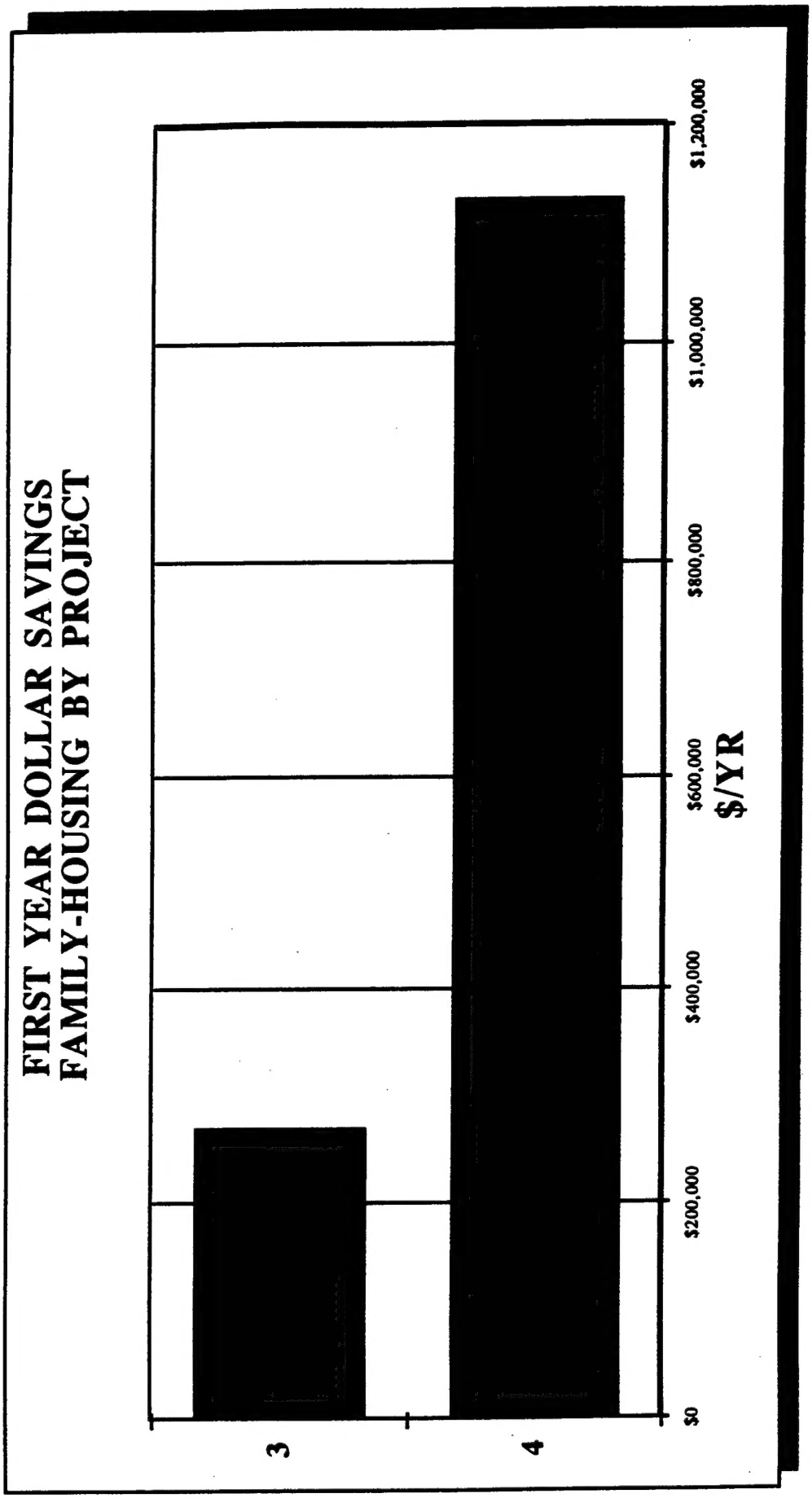

SAVINGS/INVESTMENT RATIO (SIR)
FAMILY-HOUSING BY PROJECT
SIR
0
1
2
3
4
5
6
7
8
9
10
3
4

Figure 8


FIRST YEAR DOLLAR SAVINGS
FAMILY-HOUSING BY PROJECT
$0
$200,000
$400,000
$600,000
$800,000
$1,000,000
$1,200,000
$/YR
3
4

III. PROJECT SCOPE

Criteria for the study and the documentation have changed since the previous study was completed. The previous study was a basewide Energy Engineering Analysis Program (EEAP) performed in 1979-80 by another AE. The ESOS is intended to re-evaluate selected projects from the previous study and to consider specific ECOs in buildings that may have been overlooked previously or recently identified.

A limited site survey of selected buildings or areas was performed to ensure that any new methods of energy conservation which are practical and have not been evaluated in any previous study have been considered and the results documented. Based upon on the interim submittal comments, Heery prepared programming or implementation documentation for all ECOs selected by DEH and a comprehensive report on the work, results, and recommendations.

The emphasis in the Scope of Work is on ECOs that are practical, appropriate, and not previously accomplished. Also, ECOs that can be eliminated from detailed analysis by a preliminary analysis shall be ruled out.

A "snapshot" approach is taken in this ESOS. In effect, everything is frozen in time, with the base year for this ESOS being 1986. Utility rates used were the previous full year's data available during the base year. For project programming, project costs were escalated to FY 89 per the SOW.

In preparing LCCAs and project packaging, Savannah Energy Conservation Investment Program (ECIP) Guidance was followed.

As stated in ASHRAE's Heating and Cooling Load Calculation Manual, page 7.1 "a load calculation is not an energy calculation," This is an important distinction when analyzing the ECOs and illustrates that other factors must be considered before drawing conclusions regarding building loads from the energy calculations developed in this report.

Synergistic Effects

All ECOs that use heating or cooling degree hours, or equipment efficiency data in their calculations presume that seven "primary" ECOs, listed below, were implemented first. The seven are ECOs that would affect equipment operating hours or equipment efficiencies. The seven primary ECOs are:

10 Outside Temperature Control of Space Heating
11 Thermostatic Control Valves
12 More Efficient Boilers
24 Hot Water Reset
26 Time Control of HVAC
30 Airside Drybulb Economizer Cycle
31 Time Control of DHW

The seven were chosen because they would cause interactions with other ECOs. In the event that two or more of these were being evaluated for the same building, each one assumed that the other ECO was in place, to account for interactions.

IV. SUMMARY

The total of energy savings from all programmed non-housing ECOs is 31,700 MBTU/year and $320,000/year. With a total cost of $755,000 this yields an average payback of 2.4 years and an average SIR of 4.9.

The total of energy savings from all programmed family housing ECOs is 129,000 MBTU/year and $1.4 million/year. With a total cost of $3.9 million this yields an average payback of 2.8 years and an average SIR of 5.5.

Some very fast payback projects have been developed in this report for Fort Jackson. Several of these have already been implemented including ECO Nos. 1, 9, 30 and some of the buildings in ECO No. 26.